

WHAT IS CLAIMED IS:

1. A fluid discharge pumping apparatus comprising:
a drive mechanism;
a cylinder having a discharge port at a lower end, a supply port on a side in the vicinity of discharge port, and a top opening;
an outflow valve mechanism coupled to the discharge port of the cylinder;
an inflow valve mechanism coupled to the supply port of the cylinder;
a piston member capable of reciprocating inside the cylinder; and
a piston-supporting member attached to the piston member and extending through the top opening of the cylinder and coupled to the drive mechanism, wherein the piston-supporting member is driven by the drive mechanism to move the piston member in a predetermined range inside the cylinder where the piston member does not block the inflow valve mechanism,

wherein the inflow valve mechanism opens when an interior of the cylinder is depressurized, whereas the outflow valve mechanism opens when the interior of the cylinder is pressurized.

2. The fluid discharge pumping apparatus according to Claim 1, further comprising a fluid-storing container which is connected to the supply port, wherein a fluid stored in the fluid-storing container flows into the interior of the cylinder through the inflow valve mechanism and is discharged from the outflow valve mechanism.

3. The fluid discharge pumping apparatus according to Claim 2, wherein the inflow valve mechanism is attached to the fluid-storing container.

4. The fluid discharge pumping apparatus according to Claim 1, wherein an axis of the inflow valve mechanism is angled with respect to an axis of the cylinder.

5. The fluid discharge pumping apparatus according to Claim 1, wherein the piston-supporting member is detachably coupled to the drive mechanism.

6. The fluid discharge pumping apparatus according to Claim 1, wherein the drive mechanism comprises a motor, gears, and a ball screw, wherein the piston-supporting member is engaged with the ball screw.

7. The fluid discharge pumping apparatus according to Claim 6, wherein the ball screw is engaged with the motor via the gears, and is disposed parallel to the piston-supporting mechanism.

8. The fluid discharge pumping apparatus according to Claim 7, further comprising a controller which controls revolution of the motor and changes a traveling stroke of the piston-supporting member to change a fluid discharge amount.

9. The fluid discharge pumping apparatus according to Claim 1, further comprising a housing for the drive mechanism, wherein the housing is provided with a cylinder-supporting member, and the cylinder is detachably connected to the housing via the cylinder-supporting member.

10. The fluid discharge pumping apparatus according to Claim 2, further comprising a connection mechanism which detachably connects the fluid-storing container to the supply port by.

11. The fluid discharge pumping apparatus according to Claim 1, further comprising a connection mechanism to detachably connect a fluid-receiving container to the discharge port of the cylinder.

12. The fluid discharge pumping apparatus according to Claim 1, wherein the outflow valve mechanism and the inflow valve mechanism are one-way valves which respectively comprise a resin valve seat having an opening portion, and a resin valve body having a shape corresponding to a shape of the opening portion, wherein the valve body closes the opening portion when no pressure is exerted, and the valve body moves to open the opening portion when the interior of the cylinder is pressurized.

13. The fluid discharge pumping apparatus according to Claim 12, wherein the valve body, the valve seat, and the opening portion are disposed co-axially.

14. The fluid discharging pumping apparatus according to Claim 12, wherein the valve body and the valve seat are integrated or assembled to provide a single valve mechanism unit..

15. A fluid discharge pumping apparatus comprising:

a drive mechanism to which a piston-supporting member is attached, which reciprocates in a generally vertical direction;

a cylinder disposed in a generally vertical direction, said cylinder having a discharge port at a lower end, a supply port on a side in the vicinity of discharge port, and a top opening, wherein the discharge port is provided with a one-way valve, and the supply port is provided with a one-way valve; and

a piston member capable of reciprocating inside the cylinder, wherein the piston-supporting member is attached to the piston member through the top opening of the cylinder, and the piston-supporting member moves the piston member along an axis of the cylinder,

wherein the one-way valve at the supply port opens when the piston moves upwards, whereas the one-way valve at the discharge port opens when the piston moves downwards.

16. The fluid discharge pumping apparatus according to Claim 15, further comprising a fluid-storing container which is connected to the supply port.

17. The fluid discharge pumping apparatus according to Claim 16, wherein the one-way valve is attached to a neck portion of the fluid-storing container, and the neck portion is detachably connected to the supply port.

18. The fluid discharge pumping apparatus according to Claim 15, wherein an axis of the supply port is slanted with respect to an axis of the cylinder.

19. The fluid discharge pumping apparatus according to Claim 15, wherein the drive mechanism comprises a motor, gears, and a ball screw disposed in a generally vertical direction, wherein the piston-supporting member is engaged with the ball screw.

20. The fluid discharge pumping apparatus according to Claim 19, further comprising a controller which controls revolution of the motor and changes a traveling stroke of the piston-supporting member to change a fluid discharge amount.

21. The fluid discharge pumping apparatus according to Claim 15, further comprising a housing for the drive mechanism, wherein the housing is provided with a cylinder-supporting member, and the cylinder is detachably connected to the housing via the cylinder-supporting member.

22. The fluid discharge pumping apparatus according to Claim 16, further comprising a connection mechanism which detachably connects the fluid-storing container to the supply port by.

23. The fluid discharge pumping apparatus according to Claim 15, further comprising a connection mechanism to detachably connect a fluid-receiving container to the discharge port of the cylinder.

24. The fluid discharge pumping apparatus according to Claim 15, wherein the one-way valves respectively comprise a resin valve seat having an opening portion, and a resin valve body having a shape corresponding to a shape of the opening portion, wherein the valve body closes the opening portion when no pressure is exerted, and the valve body moves to open the opening portion when the interior of the cylinder is pressurized.

25. The fluid discharge pumping apparatus according to Claim 24, wherein the valve body, the valve seat, and the opening portion are disposed co-axially.